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IS 1109 (1980): Borax [CHD 1: Inorganic Chemicals]



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“Knowledge is such a treasure which cannot be stolen”

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Indian Standard
SPECIFICATION FOR BORAX
(*Second Revision*)

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BUREAU OF INDIAN STANDARDS
MANAK BHAVAN, 9 BAHADUR SHAH ZAFAR MARG
NEW DELHI 110002

Indian Standard

SPECIFICATION FOR BORAX

(Second Revision)

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Indian Standard

SPECIFICATION FOR BORAX

(*Second Revision*)

0. FOREWORD

0.1 This Indian Standard (Second Revision) was adopted by the Indian Standards Institution on 2 January 1980, after the draft finalized by the Inorganic Chemicals (Miscellaneous) Sectional Committee had been approved by the Chemical Division Council.

0.2 Borax is sodium tetraborate, decahydrate. It finds use in a large number of industries, namely, glass, ceramics, enamel, textile, leather, fireproofing and as a general flux and as a reagent in chemical analysis. The pure grade of the material is used in cosmetics, explosives, fine chemicals, photographic and pharmaceutical industries.

0.2.1 The material is now also being used by more and more industries, namely, paint, glue, timber preservation, soaps and detergents, agriculture and wire drawing.

0.3 This standard was first published in 1957 and covered only technical grade of borax. The standard was revised in 1968 to include pure and analytical reagent grades of the material. The second revision has been necessitated by the latest developments in trade and technology. The limit for sodium tetraborate is being upgraded for technical and pure grades and changes have also been made in the method of test for this requirement.

0.3.1 The requirements for pharmaceutical and cosmetic grade of the material are being excluded as requirements for pharmaceutical industry are covered in the Indian Pharmacopoeia and a separate Indian Standard on the material for cosmetic industry is under preparation.

0.4 For the purpose of deciding whether a particular requirement of this standard is complied with, the final value, observed or calculated, expressing the result of a test or analysis, shall be rounded off in accordance with IS : 2-1960*. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

*Rules for rounding off numerical values (revised).

1. SCOPE

1.1 This standard prescribes the requirements and the methods of sampling and test for borax.

2. GRADES

2.1 There shall be three grades of the material, namely:

- a) *Technical (TECH)* — for use in glass, ceramics, enamel, textile, leather, paints, glue, timber preservation, soaps and detergents, agriculture, wire drawing and fireproofing industries and as a general flux;
- b) *Pure* — for use in explosives, fine chemicals, and photographic industries; and
- c) *Analytical Reagent (AR)* — suitable for use as a reagent in chemical analysis.

3. REQUIREMENTS

3.1 **Description** — The material of the three grades shall be in the form of hard, colourless or white crystals, granules or powder consisting essentially of sodium tetraborate decahydrate ($\text{Na}_2\text{B}_4\text{O}_7 \cdot 10\text{H}_2\text{O}$). It shall be free from visible impurities and other foreign matter.

3.2 The material shall comply with the requirements given in Table 1, when tested according to the methods prescribed in Appendix A. Reference to the relevant clauses of Appendix A is given in col 6 of the table.

4. PACKING AND MARKING

4.1 **Packing** — The technical and pure grades of the material shall be packed in well-closed, sound, clean and dry jute bags lined with polyethylene sheets or as agreed to between the purchaser and the supplier.

4.1.1 The analytical reagent grade shall be packed in well-closed wide-mouth glass or polyethylene bottles.

4.2 **Marking** — The containers shall be securely closed and legibly and indelibly marked with the following information:

- a) Name and grade of the material;
- b) Name of the manufacturer and his recognized trade-mark, if any;
- c) Gross and net mass;
- d) Date of manufacture; and
- e) Batch number.

TABLE 1 REQUIREMENTS FOR BORAX

(Clause 3.2)

Sl. No.	CHARACTERISTIC	REQUIREMENT FOR GRADE			METHOD OF TEST, REF TO CL No. IN APPENDIX A
		TECH	Pure	AR	
(1)	(2)	(3)	(4)	(5)	(6)
i)	Sodium tetraborate decahydrate ($\text{Na}_2\text{B}_4\text{O}_7 \cdot 10\text{H}_2\text{O}$) content, percent by mass	99.5 to 103.0	99.5 to 103.0	99.5 to 101.5	A-2
ii)	Matter insoluble in water, percent by mass, <i>Max</i>	0.1	0.01	0.005	A-3
iii)	Carbonates	—	To pass test	To pass test	A-4
iv)	Chlorides (as Cl), percent by mass, <i>Max</i>	—	0.035	0.001	A-5
v)	Sulphates (as SO_4), percent by mass, <i>Max</i>	—	0.12	0.005	A-6
vi)	Phosphates (as PO_4), percent by mass, <i>Max</i>	—	—	0.002	A-7
vii)	Iron (as Fe), percent by mass, <i>Max</i>	—	0.008	0.000 5	A-8
viii)	Calcium	—	—	To pass test	A-9
ix)	Heavy metals (as Pb), mg/kg, <i>Max</i>	—	20	10	A-10
x)	Arsenic (as As_2O_3), mg/kg, <i>Max</i>	—	13	5	A-11
xi)	pH value	9.0 to 9.5	9.0 to 9.5	9.0 to 9.5	A-12
<i>Additional Requirement for Photographic Industry</i>					
xii)	Reaction to ammoniacal silver nitrate	—	To pass test	—	A-13

4.2.1 For analytical reagent grade, full details of analysis as prescribed in col 5 of Table 1 shall also appear on the label.

4.2.2 The containers may also be marked with the ISI Certification Mark.

NOTE — The use of the ISI Certification Mark is governed by the provisions of the Indian Standards Institution (Certification Marks) Act and the Rules and Regulations made thereunder. The ISI Mark on products covered by an Indian Standard conveys the assurance that they have been produced to comply with the requirements of that standard under a well-defined system of inspection, testing and quality control which is devised and supervised by ISI and operated by the producer. ISI marked products are also continuously checked by ISI for conformity to that standard as a further safeguard. Details of conditions under which a licence for the use of the ISI Certification Mark may be granted to manufacturers or processors, may be obtained from the Indian Standards Institution.

5. SAMPLING

5.1 The method of drawing representative samples of the material, number of tests to be performed on each and the criteria for conformity to the requirements of this specification shall be as prescribed in Appendix B.

APPENDIX A

(Clause 3.2)

METHODS OF TEST FOR BORAX

A-1. QUALITY OF REAGENTS

A-1.1 Unless specified otherwise, pure chemicals and distilled water (see IS : 1070-1977*) shall be employed in tests.

NOTE — ' Pure chemicals ' shall mean chemicals that do not contain impurities which affect the results of analysis.

A-2. SODIUM TETRABORATE, DECAHYDRATE

A-2.0 Outline of the Method — Borax is determined by first converting it to boric acid with hydrochloric acid and then titrating against sodium hydroxide solution after complexing boric acid with mannitol or sorbitol.

A-2.1 Reagents

A-2.1.1 *Standard Hydrochloric Acid* — 0.5 N.

A-2.1.2 *Standard Sodium Hydroxide* — 1 N.

A-2.1.3 *Methyl Red Indicator* — Dissolve 0.1 g of the material in 60 ml of rectified spirit and dilute with water to 100 ml.

A-2.1.4 *Phenolphthalein Indicator* — Dissolve 1 g of the material in 100 ml of rectified spirit.

A-2.1.5 *Mannitol or Sorbitol*

A-2.2 Procedure — Dissolve 3.0 g of the material, accurately weighed, in 60 ml of water and titrate with hydrochloric acid, using methyl red solution as indicator. Boil and cool the solution, add 20 g of mannitol or sorbitol, and titrate with sodium hydroxide, using phenolphthalein solution as indicator.

*Specification for water for general laboratory use (second revision).

A-2.3 Calculation

Sodium tetraborate decahydrate
 ($\text{Na}_2\text{B}_4\text{O}_7 \cdot 10\text{H}_2\text{O}$), percent by mass = $\frac{9.534 VN}{M}$

where.

V = volume in ml of standard sodium hydroxide used,

N = normality of sodium hydroxide, and

M = mass in g of the material taken for the test.

A-3. MATTER INSOLUBLE IN WATER

A-3.1 Procedure — Dissolve 20 g of the material in 300 ml of hot water and heat on a steam-bath for one hour. Filter any undissolved residue through a sintered glass crucible, wash it with hot water and dry at 105°C. Cool and weigh the residue till constant mass is obtained.

A-3.2 Calculation

Matter insoluble in water,
 percent by mass = $100 \times \frac{M_1}{M}$

where

M_1 = mass in g of the residue, and

M = mass in g of the material taken for the test.

A-4. CARBONATES

A-4.1 Reagents

A-4.1.1 Dilute Hydrochloric Acid — 0.5 N.

A-4.2 Procedure

A-4.2.1 Weigh accurately about 1 g of the material, dissolve in 10 ml of warm water and add 2 ml of dilute hydrochloric acid. The material shall conform to the requirements of the test if no effervescence is produced.

A-5. CHLORIDES

A-5.0 Outline of the Method — Chlorides are determined by comparing the opalescence produced by the material with silver nitrate solution against that produced by standard hydrochloric acid.

A-5.1 Apparatus

A-5.1.1 *Nessler Cylinders* — 50 ml capacity (see IS : 4161-1967*).

A-5.2 Reagents

A-5.2.1 *Standard Hydrochloric Acid* — 0.01 N.

A-5.2.2 *Dilute Nitric Acid* — approximately 5 N.

A-5.2.3 *Silver Nitrate Solution* — 5 percent (*m/v*).

A-5.3 Procedure

A-5.3.1 *For Pure Grade* — Place 1 ml of standard hydrochloric acid and 10 ml of dilute nitric acid in a Nessler cylinder. Dilute to 50 ml with water and add 1 ml of silver nitrate solution. Stir immediately with a glass rod and set aside in the dark for 5 minutes. Dissolve 1 g of the material in 25 ml of warm water in another Nessler cylinder. Add 10 ml of dilute nitric acid. Dilute to 50 ml with water and add 1 ml of silver nitrate solution. Stir immediately with a glass rod and set aside in the dark for 5 minutes. The material shall conform to the requirements of the test if the opalescence produced is not greater than that produced in the control test.

A-5.3.2 *For Analytical Reagent Grade* — Weigh accurately about 2 g of the material and dissolve in about 50 ml of warm water. Add 3 ml of dilute nitric acid and 1 ml of silver nitrate solution. The material shall conform to the requirements of the test if no opalescence is produced.

A-6. SULPHATES

A-6.1 For Pure Grade

A-6.1.0 *Outline of the Method* — Sulphates are determined by comparing the turbidity produced by the material with alcoholic barium chloride solution against that produced by a standard sulphate solution.

A-6.1.1 Reagents

A-6.1.1.1 *Concentrated hydrochloric acid* — See IS : 265-1976†.

A-6.1.1.2 *Barium chloride solution* — Dissolve 122.2 g of barium chloride ($\text{Ba Cl}_2 \cdot 2\text{H}_2\text{O}$) in 1 000 ml of water.

*Specification for Nessler cylinders.

†Specification for hydrochloric acid (*second revision*).

A-6.1.1.3 Alcoholic barium chloride solution — Mix 15 ml of barium chloride solution (*see* **A-6.1.1.2**), 55 ml of water and 20 ml of sulphate-free ethyl alcohol (95 percent), add 0.018 1 percent (*m/v*) solution of potassium sulphate and dilute to 100 ml with water and mix.

A-6.1.1.4 Standard sulphuric acid — 0.01 N.

A-6.1.1.5 Dilute hydrochloric acid — 5 N.

A-6.1.2 Procedure — Dissolve 1 g of the material in 20 ml of water by warming. Transfer to a Nessler cylinder, add 1 ml of concentrated hydrochloric acid and dilute to 50 ml with water. Add 5 ml of alcoholic barium chloride solution, stir immediately with a glass rod and set aside for 5 minutes. Carry out a control test in a similar manner in another Nessler cylinder using 2.5 ml of standard sulphuric acid in place of the material and the same quantities of other reagents.

A-6.1.2.1 The material shall be considered to have not exceeded the limit for sulphate as laid down in Table 1 if the turbidity produced by the material is not greater than in the control test.

A-6.2 For Analytical Reagent Grade

A-6.2.1 Procedure — Weigh accurately 2 g of the material and dissolve in 50 ml of warm water, add 3 ml of dilute hydrochloric acid and 5 ml of alcoholic barium chloride solution and allow to stand for one hour. Carry out a control test in a similar manner in another Nessler cylinder using 0.2 ml of standard sulphuric acid in place of the material and the same quantities of other reagents.

A-6.2.1.1 The material shall be considered to have not exceeded the limit for sulphate if the turbidity produced is not greater than in the control test.

A-7. PHOSPHATES

A-7.0 Outline of the Method — Phosphates are determined by comparing the colour produced with ammonium molybdate reagent against a standard phosphate solution.

A-7.1 Reagents

A-7.1.1 Dilute Sulphuric Acid — approximately 5 N and 1 N.

A-7.1.2 Phosphate Reagent No. 1 — Dissolve without heating 5 g of ammonium molybdate in 100 ml of 1 N sulphuric acid.

A-7.1.3 Phosphate Reagent No. 2 — Dissolve without heating 0.2 g of *n*-methyl-*p*-aminophenol sulphate (Metol) and 20 g of potassium metabisulphite in 100 ml of water.

A-7.1.4 Standard Phosphate Solution — Dissolve 1.43 g of potassium dihydrogen orthophosphate in 1 000 ml of water and store in a stoppered polyethylene bottle. Dilute 1 ml of this solution to 100 ml with water immediately before use. One millilitre of this diluted solution is equivalent to 0.01 mg of phosphate (as PO_4).

A-7.1.5 Standard Colour for Phosphate Test — Mix 1 ml of standard phosphate solution (see A-7.1.4) with 20 ml of water, 3 ml of 5 N sulphuric acid, 1 ml of phosphate reagent No. 1 and 1 ml of phosphate reagent No. 2 and place in a water-bath at 60°C for 10 minutes.

A-7.2 Procedure — Dissolve 0.5 g of the material in 15 ml of water and neutralize with 1 N sulphuric acid. Add 3 ml of 5 N sulphuric acid, 1 ml of phosphate reagent No. 1 and 1 ml of phosphate reagent No. 2 and place on a water-bath at 60°C for 10 minutes. The material shall conform to the requirement of the test if any colour produced is not deeper than the standard colour prepared as in A-7.1.5.

A-8. IRON

A-8.0 Outline of the Method — Iron is determined colorimetrically by visual comparison using potassium thiocyanate.

A-8.1 Apparatus

A-8.1.1 Nessler Cylinder — 50 ml capacity (see IS : 4161-1967*).

A-8.2 Reagents

A-8.2.1 Concentrated Hydrochloric Acid — See IS : 265-1976†.

A-8.2.2 Ammonium Persulphate — solid.

A-8.2.3 Butanolic Potassium Thiocyanate — Dissolve 10 g of potassium thiocyanate in 10 ml of water. Add sufficient *n*-butanol to make up the volume to 100 ml and shake vigorously until the solution is clear.

A-8.2.4 Standard Iron Solution — Dissolve 0.702 g of ferrous ammonium sulphate [$\text{FeSO}_4 (\text{NH}_4)_2 \text{SO}_4 \cdot 6\text{H}_2\text{O}$] in water and add 10 ml of dilute sulphuric acid (10 percent *v/v*). Dilute the solution to one litre. Take 10 ml of this solution and dilute to 100 ml before use. One millilitre of this solution contains 0.01 mg of iron (as Fe).

A-8.3 Procedure — Dissolve 1.0 g of the material in 10 ml of water in a Nessler cylinder. Add 2 ml of hydrochloric acid, 30 mg of ammonium persulphate and 15 ml of butanolic potassium thiocyanate solution. Shake vigorously for 30 seconds and allow the liquids to separate.

*Specification for Nessler cylinders.

†Specification for hydrochloric acid (second revision).

Carry out a control test in another Nessler cylinder with 8 ml of standard iron solution in place of the sample in case of pure grade and 0.5 ml of standard iron solution in case of analytical reagent grade, and the same quantities of other reagents in the same total volume of the reaction mixture. Compare the colour of the butanol layer in the two sets.

A-8.3.1 The limits prescribed in Table 1 shall be taken as not having been exceeded if the colour of the butanol layer in the test with the material is not darker than the colour produced in the control test.

A-9. CALCIUM

A-9.1 Reagents

A-9.1.1 *Dilute Acetic Acid* — approximately 5 N.

A-9.1.2 *Ammonium Oxalate Solution* — 3.5 percent *m/v*.

A-9.2 Procedure — Dissolve 2 g of the material in 25 ml of hot water, add 3 ml of dilute acetic acid and 5 ml of ammonium oxalate solution and allow to stand for 10 minutes. The material shall conform to the requirements of the test if no turbidity or precipitate is produced.

A-10. HEAVY METALS

A-10.0 Outline of the Method — Heavy metals are determined by comparing the colour produced by the material with hydrogen sulphide solution against that produced by a standard lead solution.

A-10.1 Apparatus

A-10.1.1 *Nessler Cylinder* — 50 ml capacity (see IS : 4161-1967*).

A-10.2 Reagents

A-10.2.1 *Dilute Hydrochloric Acid* — 1 N.

A-10.2.2 *Acetic Acid* — approximately 33 percent (*m/m*).

A-10.2.3 *Hydrogen Sulphide Solution* — saturated.

A-10.2.4 *Standard Lead Solution* — Dissolve 159.8 mg of lead nitrate in 100 ml of water containing 1 ml of concentrated nitric acid and dilute to exactly 1 000 ml with water. Dilute 10 ml of this stock solution to exactly 100 ml with water. One millilitre of this solution is equivalent to 0.01 mg of lead (as Pb).

*Specification for Nessler cylinders.

A-10.3 Procedure — Dissolve 1.0 g of the material in 16 ml of water and 6 ml dilute hydrochloric acid and add water to make 25 ml. Transfer to a Nessler cylinder 2 ml of acetic acid, 10 ml of hydrogen sulphide solution and dilute to the mark with water. Carry out a control test in another Nessler cylinder using 2 ml of standard lead solution in case of pure grade and 1 ml in case of analytical reagent grade and the same quantities of other reagents in the same total volume of the mixture.

A-10.3.1 The limits prescribed in Table 1 shall be considered as not having been exceeded if the colour produced by the material is not greater than that in the control test.

A-11. ARSENIC

A-11.1 Procedure — Dissolve 1.0 g of the material in 10 ml of water. Carry out the test for arsenic as prescribed in IS : 2088-1971* using for comparison a stain obtained with 0.013 mg of arsenic trioxide (as As_2O_3) in case of pure grade and 0.005 mg in case of analytical reagent grade.

A-12. pH VALUE

A-12.1 Procedure — Dissolve 3.8 g of the material in water and make it to 100 ml. Measure the pH value of the solution with the help of suitable pH meter, using glass electrodes.

A-13. TEST FOR REACTION TO AMMONIACAL SILVER NITRATE

A-13.1 Reagents

A-13.1.1 Concentrated Ammonium Hydroxide — 20 percent (m/v).

A-13.1.2 Silver Nitrate Solution — 10 percent (m/v).

A-13.1.3 Ammoniacal Silver Nitrate Solution — Mix equal volumes of ammonium hydroxide and silver nitrate solutions.

A-13.2 Procedure — Dissolve about 1 g of the material in 20 ml of water. Add 10 ml of freshly prepared ammoniacal silver nitrate solution and mix well. Let the solution stand for two minutes and then compare it with the colour of the blank solution prepared by adding 5 ml of ammonium hydroxide to a solution of 1 g of the sample in 25 ml

*Methods for determination of arsenic (*first revision*).

of water. The material shall conform to the requirements of the test if any colour or precipitate produced in the above solution is not greater than that produced in the blank.

NOTE — Dispose of all reagents and test solutions and rinse all apparatus immediately. Explosive compounds may be formed on standing.

A P P E N D I X B

(*Clause 5.1*)

SAMPLING OF BORAX

B-1. GENERAL REQUIREMENTS OF SAMPLING

B-1.0 In drawing, preparing, storing and handling samples, the following precautions and directions shall be observed.

B-1.1 Samples shall not be taken in an exposed place.

B-1.2 The sampling instrument shall be clean and dry when used.

B-1.3 Precautions shall be taken to protect the samples, the material being sampled, the sampling instrument and the containers for samples from adventitious contamination.

B-1.4 The samples shall be placed in clean, dry and air-tight glass or any other suitable containers on which the material has no chemical action.

B-1.5 The sample containers shall be of such a size that they are almost completely filled by the sample.

B-1.6 Each sample container shall be suitably stoppered and sealed air-tight after filling and marked with full particulars of the material and the date of sampling.

B-1.7 Samples shall be stored in a cool and dry place.

B-2. SCALE OF SAMPLING

B-2.1 Lot — All the packages in a single consignment containing the material of the same grade, drawn from a single batch of manufacture shall constitute a lot.

B-2.2 For ascertaining the conformity of the material to the requirements of this specification, samples shall be tested for each lot separately. The number of packages to be selected at random from lots of different sizes shall be in accordance with Table 2.

TABLE 2 NUMBER OF PACKAGES TO BE SELECTED

LOT SIZE	SAMPLE SIZE
N	n
(1)	(2)
3 to 25	3
26 to 100	4
101 to 300	5
301 to 500	6
501 to 1 000	7
1 001 and above	8

B-2.3 The packages for this purpose shall be selected at random from the lot. In order to ensure randomness of selection, use shall be made of IS : 4905-1968*. In case random number tables are not available, the following procedure may be adopted:

Starting from any package, count all the packages in the lot as 1, 2, 3,... up to r and so on. Every r th package thus counted shall be withdrawn to constitute the sample where r is the integral part of N/n (N being the lot size and n the sample size).

B-3. INDIVIDUAL SAMPLES AND COMPOSITE SAMPLES

B-3.1 Preparation of Sets of Individual Samples — Draw with an appropriate sampling instrument equal portions of material from different parts of each of the containers selected in B-2.2. The quantity of material so drawn from each container shall be sufficient to make triplicate determinations given in 3 of the specification. Mix these small portions of the material from the same container to obtain the sample representative of the container. Keep these representative samples from different containers separately. From each representative sample draw three equal portions of material each sufficient for carrying out the intended tests and transfer them to thoroughly clean and dry

*Methods for random sampling.

sample containers. Seal the sample containers air-tight. Thus three sets of test samples are obtained such that each set has a test sample from each selected container. One of these sets shall go to the purchaser and one to the supplier. The third set shall be reserved as a referee set.

B-3.2 Preparation of Composite Sample — From each of the samples representative of the selected containers as obtained in B-3.1, take small and equal portions of material and mix them thoroughly to constitute a single composite sample representing the lot as a whole. Divide this composite sample into three equal parts each sufficient for carrying out the intended tests and transfer them to thoroughly clean and dry sample containers. One of these composite samples shall go to the purchaser and one to the supplier. The third composite sample shall be reserved as a referee sample.

B-3.3 Referee Sample — A referee sample shall consist of a set of individual samples from B-3.1 and composite sample from B-3.2. The referee sample shall bear the seals of the purchaser and the supplier or their authorized representatives. The referee sample shall be kept at a place mutually agreed to between the parties.

B-4. NUMBER OF TESTS

B-4.1 Tests for the determination of sodium tetraborate decahydrate and matter insoluble in water shall be carried out on each of the individual sample in a set.

B-4.2 Tests for the determination of the remaining characteristics shall be performed on the composite sample only.

B-5. CRITERIA FOR CONFORMITY

B-5.1 For Individual Samples — For the characteristics tested on the individual samples, namely, sodium tetraborate decahydrate and matter insoluble in water, the lot shall be considered to be in conformity to these requirements if each of the test result individually satisfies the relevant requirements.

B-5.2 For Composite Sample — For declaring the conformity of the lot to the requirements of all the characteristics tested on the composite sample, the test results shall satisfy the corresponding specified requirements.

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